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(54) **Polymer** Electret and Its Manufacturing Method

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(71) Patent Assignee: Tokyo Denki Kagaku Kogyo Company

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[Note: Names, addresses, company names and brand names are translated in the most common manner. Japanese language does not have singular or plural words unless otherwise specified by a numeral prefix or a general form of plurality suffix.]

(54) Polymeric Electret and Its Manufacturing Method

(57) Scope of the Claims

1. Polymeric electret which is formed from ionomer resin material, which can be represented according to the general formula

(where, M represents a metal ion0.

2. Manufacturing method for the preparation of polymeric electret according to the Claim paragraph 1 reported above, where the ionomer resin is electretized at a temperature within the range of 50oC ~ 80oC.

Detailed Explanation of the Invention

The present invention is an invention about a polymeric electret and its manufacturing method.

Usually, the polymeric electret is characterized by the fact that it is produced as a polymeric material is maintained at a high temperature that is at or above its melting point temperature, and

also, a polarization is conducted through the action of an electric field, and in the state as the electrical field is being applied, it is cooled to room temperature, and this polarization is frozen and it is maintained for a long period of time.

In the past, the use of polyvinyl chloride, polyvinyl acetate, polyethylene, Teflon, etc., different polymers as electret materials, has been known. However in the case of the electrets obtained from these materials, the change with the passing of time of their surface electric charge is large, and because of that the application in condenser type microphones etc., has been difficult.

The present invention is an invention, which has as a goal to solve such surface electric charge instabilities, and to suggest a polymeric electret with stable surface electric charge and its manufacturing method.

The authors of the present invention have conducted different studies in order to obtain polymer electret with stable surface electric charge, and as a result from that they have observed that ionomer resins have excellent electret characteristics and the present invention has been achieved.

The ionomer resin is a material characterized by the fact that the long chain molecules are connected through ionic bonds, and because of that their structure is represented as shown in Figure 1, where as M, Na, Zn etc., can be used.

Here below, practical implementation examples will be presented and the present invention will be explained in details.

A 300 micron thick film produced from ionomer resin material represented according to the structural formula

(trade name: Sarin 1601, manufactured by Dupont Company), was used and at different polarization temperatures, 300 KV/cm electric field was applied, and it was equilibrated for a period of 30 minutes, and after that it was cooled down to room temperature and the electric field was withdrawn and electrets were produced.

The relationship between the rate of change of the surface electric change of these electrets after 150 days and the polarization temperature, is presented in Figure 2.

Moreover, the longitudinal axis represents the % change of the surface electric charge after 150 days, relative to the initial surface electric charge, and + represents an increase, and – represents a decrease.

According to Figure 2, around the softening point temperature, namely, in the 50oC ~ 80oC polarization range temperature, it can be stated that the change of the surface electric charge with the passing of the time is small.

It is understood that because of the fact that the softening point of the ionomer resin is around 70oC, when the ionomer resin polarization temperature is made to be close to the softening point, the surface electric charge is most stable.

Practical Example 1

At a polarization temperature of 70oC, a 100 kV/cm electric field was applied for a period of 30 minutes and the material was equilibrated, and after it was cooled to room temperature, the electric field was taken away, and the surface electric charge change coefficient of the ionomer electret after 150 days was + 10 %, and the surface charge density was 7 x 10^{-9} Coulon/cm2.

Practical Example 2

At a polarization temperature of 60oC, a 30 kV/cm electric field was applied for a period of 30 minutes and the material was equilibrated, and after it was cooled to room temperature, the electric field was taken away, and the surface electric charge change coefficient of the ionomer electret after 150 days was - 5 %, and the surface charge density was 8 x 10^{-9} Coulon/cm2.

As it is shown according to the above described practical implementation examples, the ionomer electret according to the present invention is an electret, which has a small change of the surface electric charge with the passing of time, and it maintains the surface electric charge for a long period of time, and because of that it demonstrates excellent properties when used as condenser type microphones, cartridges used for records etc.

Brief Explanation of the Figures

Figure 1 represents a structural diagram of the ionomer resin material, Figure 2 represents a diagram of the change of the surface electric charge of the ionomer electret depending on the polarization temperature.

In Figure 2:

On the vertical axis – coefficient of change of the surface electric charge (%)
On the horizontal axis – polarization temperature (oC)

Patent Assignee: Tokyo Denki Kagaku Kogyo Company

Translated by Albena Blagev ((651) 735-1461 (h), (651) 704-7946 (w))

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⑭高分子エレクトレットおよびその製造方法

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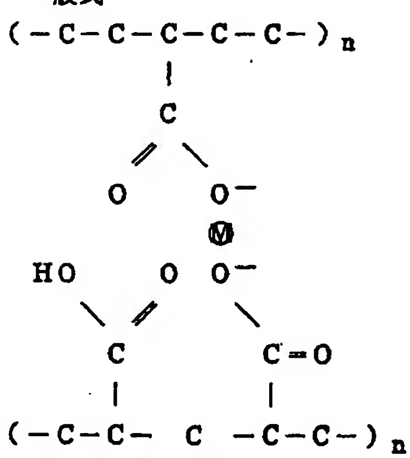
㊸昭48(1973)7月18日

⑫発明者 上条輝文
東京都千代田区内神田2の14の6東京電気化学工業株式会社内
同 稲垣誠
同所
同 永薗和郎
同所
⑪出願人 東京電気化学工業株式会社
東京都千代田区内神田2の14の6

㊼特許請求の範囲

1 一般式



(ただし、Mは金属イオン)

でしめされるアイオノマー樹脂からなる高分子エレクトレット。

2 アイオノマー樹脂を50℃～80℃の温度範囲でエレクトレット化することを特徴とする特許請求の範囲第1項記載の高分子エレクトレットの製造方法。

発明の詳細な説明

本発明は、高分子エレクトレットおよびその製造方法に関する。

一般に高分子エレクトレットは、高分子材料をその軟化点温度以上の高温中に保持し、

かつ電場を作用させて分極を行ない、電場を加えたままの状態で室温まで冷却することにより作成され、その分極は凍結されて長い間持続することを特徴とするものである。

従来、ポリ塩化ビニル、ポリ酢酸ビニル、ポリエチレン、テフロンなどの各種高分子がエレクトレット材料として知られているが、これらの材料から得られるエレクトレットはその表面電荷の経時変化が大きいために、コンデンサー型マイクロホンなどへの応用が困難であつた。

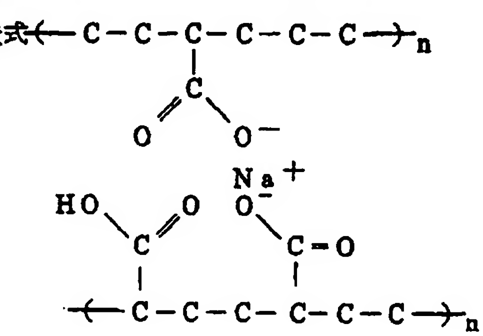
本発明はかかる表面電荷の不安定性を解消し、表面電荷の安定なる高分子エレクトレットおよびその製造方法を提供することを目的とするものである。

本発明者等は、表面電荷の安定なる高分子エレクトレットを得るために、種々検討の結果、アイオノマー樹脂がすぐれたエレクトレット特性を有することを見出し本発明に達したものである。

アイオノマー樹脂は、長鎖分子間がイオン結合によつて連結されていることを特徴とするもので、その構造は、第1図に示すとおりであり、MとしてはNa，Zn等が用いられている。

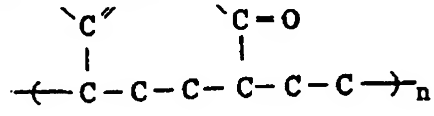
以下、実施例をあげて本発明を詳細に説明する。

構造式



n＝65～70

2　アイオノマー樹脂を50℃〜80℃の温度範囲でエレクトレット化することを特徴とする特許請求の範囲第1項記載の高分子エレクトレットの製造方法。



n＝65〜70

で示されるアイオノマー樹脂（デユポン社製、商品名サーリン1601）の厚さ300μのフイルムを使用し、種々の分極温度中で300KV／cmの電場を加え、30分間安定後室温まで冷却して電場を取り去りエレクトレットを作成した。

これらのエレクトレットの表面電荷の150日後の変化率と分極温度との関係を第2図に示す。

なお、タテ軸は初期の表面電荷に対する150日後の表面電荷の変化量を％で表示してあり、＋は増加を、－は減少を表わしている。

第2図より、軟化点付近、すなわち50℃～80℃の分極温度範囲で表面電荷の経時変化が小さくなつているといえる。

アイオノマー樹脂の軟化点は70℃附近にあるので、アイオノマー樹脂では分極温度を軟化点近辺にしたとき表面電荷が最も安定であることがわかる。

実施例　1

70℃の分極温度中で100KV／cmの電場を加えつつ30分間安定させ、室温まで冷却後電場を取り去つて作成したアイオノマーエレクトレットの150日後の表面電荷の変化率は＋10％であり、表面電荷密度は7×10^{-9}クーロン／cm²であつた。

実施例　2

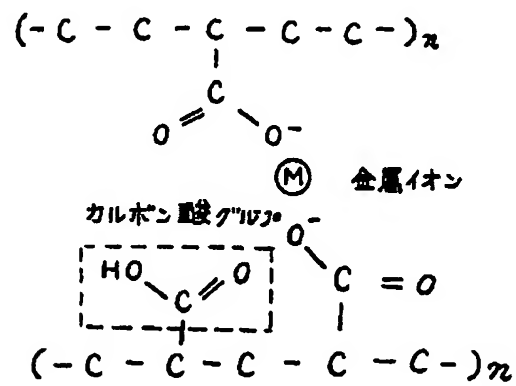
分極温度60℃で30KV／cmの電場を作用させながら30分間安定させ、室温まで冷却後電場を取り去つて作成したアイオノマーエレクトレットの150日後の表面電荷の変化率は－5％であり、表面電荷密度は8×10^{-9}クーロン／cm²であつた。

以下の実施例に示すように本発明のアイオノマーエレクトレットは表面電荷の経時変化が少なく、長い間大きい表面電荷を維持するのでコンデンサー型マイクロホン、レコード用カートリツジなどに用いてすぐれた特性を発揮するものである。

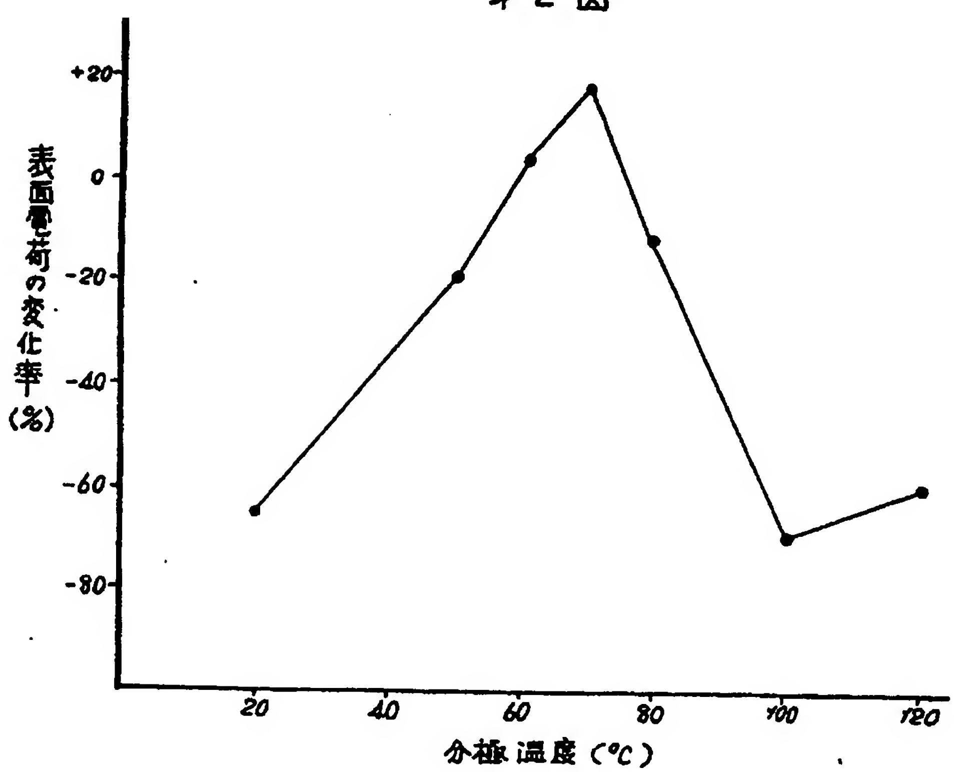
図面の簡単な説明

第1図はアイオノマー樹脂の構造図、第2図はアイオノマーエレクトレットの表面電荷の分極温度による経時変化図である。

第1図


M
金属イオン
カルボン酸グループ

第2図


表面電荷の変化率 (%)
+20
0
-20
-40
-60
-80
20
40
60
80
100
120
分極温度 (°C)